

A Robust H^∞ Design Arrives Saturn in the Year of 2004 *

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Abstract

Saturn, one of the most interesting planet in our solar system, will be visited by Cassini spacecraft in 2004. Cassini spacecraft will be launched in 1997 and arrive Saturn orbit in 2004 for a four-year mission of orbiting Saturn and flying by its largest moon Titan, which scientists believe containing materials just like earth at its primitive stage millions years ago.

Robust control *analysis* technique plays a role of analyze the attitude control system robustness. Both Thruster Vectoring Control (TVC) and Reaction Wheel Assembly (RWA) control systems will be analyzed against Cassini highly uncertain fuel slosh and flexible boom dynamics. Robust Control *synthesis* technique plays a role of designing an Reaction Control Subsystem (RCS) controller to point the spacecraft antenna for radar mapping the Titan surface images back to earth in the presence of large Titan aerodynamic

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disturbance. The disturbance level at Titan turns out to be the largest ever being exposed to a planetary spacecraft (1 million times higher than Voyager; 5 times higher than Galileo).

This presentation will highlight some robust control analysis/synthesis results of designing Cassini spacecraft attitude control system and show how they can be resolved by using the latest MATLAB tools. Specific topics will be presented are

- Saturn and Cassini mission (a slide show)
- Robustness analysis for Cassini attitude control systems
- Cassini robust attitude controller design for Titan flyby

This is a unique opportunity of bringing MATLAB tools and real world control system design together. This is a moment both MathWorks employees and JPL spacecraft designers should be proud of.

References

- [1] R. Y. Chiang, S. Lisman, E. Wong, P. Enright, W. Breckenridge, M. Jahanshahi, "Robust Attitude Control for Cassini Spacecraft Flying by Titan," *Proc. of AIAA Guidance and Control Conf.*, Monterey, CA., Aug. 1993.
- [2] R. Y. Chiang, "Parametric Robustness Analysis for Cassini Spacecraft Using L₁/L₂ Approach without Frequency Sweep," *Submitted to 1994 American Control Conf.*
- [3] M. G. Safonov, R. Y. Chiang, "Real/Complex K_m Synthesis without Curve Fitting," in C. J. Leondes, editor, *Control and Dynamic Systems*, Academic Press, 1993.
- [4] R. Y. Chiang and M. G. Safonov, *Robust Control Toolbox, Version 2*. The MathWorks, Inc. 1988-1993,